A CASE OF BROWN-SEQUARD PARALYSIS, DUE TO A FALL UPON THE HEAD; OPERATION; AUTOPSY.[1]

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Cases of Brown-Séquard paralysis are not so frequent but that individual cases may be reported, thus adding to our knowledge of the causation of this peculiar affection, with a view of stimulating research along therapeutic lines.

The following case which was observed in the Buffalo General Hospital, offers some features not commonly met with in the study and observation of these interesting conditions. It is the first case observed at the hospital and naturally led to some speculation as to its identity, as the early part of the clinical history will show.

C. H., colored, age twenty-two, male, born in the United States. Height, 5 feet, 7 inches; weight, 140 pounds. Occupation stable-boy, following the races, and was employed in this capacity at Fort Erie, Canada, opposite Buffalo, when the accident occurred.

Family History: Negative; had the grippe when fifteen years old, and typhoid fever when ten years old. On the evening of July 7th, 1904, he fell from a hayloft, a distance of twenty feet and struck on his head. The hospital reports are now given verbatim: He was unconscious and did not come to until his arrival at the hospital, an interval of perhaps one hour. He says he slept all the way.

On entering he complains of a very sore neck, the muscles of the back of the neck being very painful, also complains of pain in the left arm and leg, neither of which he could move. He says his head was not injured as he felt no pain anywhere there. The back of the neck, however, was painful, especially over the fourth and fifth cervical vertebræ and on attempting to move the head he would cry out with pain. The same pain was also provoked on moving the left arm or leg. Examination made by a member of the house staff on the evening of his entrance revealed the following condition: There is present no fracture or dislocation. General muscular soreness is present, especially on moving the head. There is a slight laceration over the right ear, otherwise no contusion or abrasion of the skin could be found.

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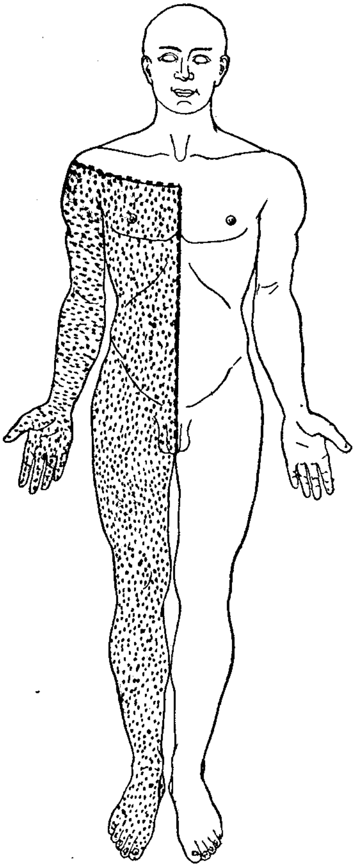
[1] Read at the meeting of the American Neurological Association, June 1, 2 and 3, 1905.

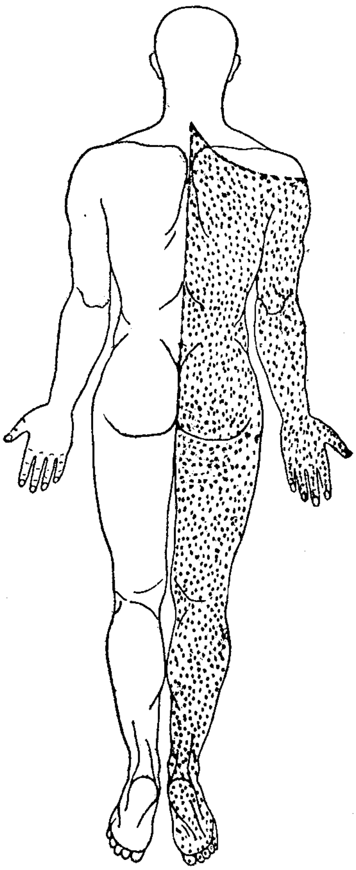
Heart and lungs are normal, likewise the abdominal organs. Patient cannot move left arm or leg.

July 10.—Patient much improved, still cannot move left arm or leg. Sensation of same is present.

July 17.—Paralysis is seemingly still present in the left arm, and the arm is used with difficulty, but still improving; the left leg can be used somewhat.



Sensory Involvement.

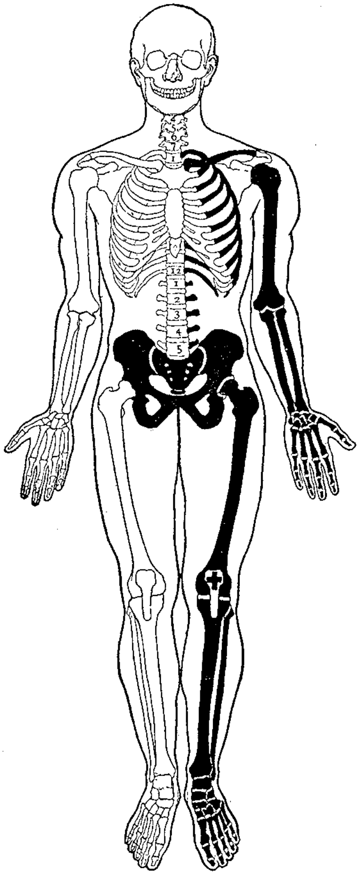


Sensory Involvement.

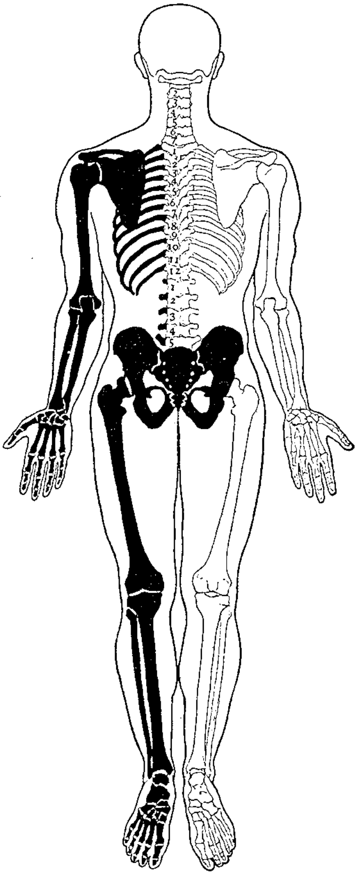
July 19.—Patient made to get out of bed. The paralysis believed to be a fake. The supposed paralyzed parts improving.

July 22.—Very marked improvement in above conditions.

On July 26, 1904, I was asked to see the patient with a view of suggesting something to hasten his improvement and his discharge from the hospital. I found him in the general ward with head somewhat retracted and stiffened. His expression was that of one suffering pain. The eyes, pupils and ocular muscles were normal in their movements. No asymmetry of the face and no deviation of the tongue. Hearing was normal and he gave no history of otorrhea. Percussion of head was not painful and no scars could be found. The back of the neck over the fourth and fifth cervical vertebræ was exceedingly painful and he resisted movement of the head. It seemed as if the soft parts were slightly swollen over this region and it was almost possible to detect crepitus at times. The sensation of the face and neck was unimpaired.



Motor Involvement.



Motor Involvement.

Ventral aspect—Right side: Sensation is interfered with, beginning at a level of about two inches below the clavicle and extending caudad—affecting the right arm, right half of trunk to the median line and right leg. Anesthesia complete, with analgesia, thermo-anesthesia are present, extending over this area. Motion of the right arm, right leg and right side of the chest are not impaired. The muscle reflexes, tendon reflexes, and abdominal reflex are active and normal.

Left side: Sensation: There is no impairment of sensation, except a hyperesthesia limited to the whole of the left side—so severe that patient cries out when the skin is slightly touched. This hyperesthesia is referable to touch, temperature and pain.

Motion: The left arm is almost helpless, some slight motion is present about the shoulder joint, but the arm and hand muscles are powerless. The movements of the left side of the thorax are markedly diminished, the excursions of this side of the chest is in marked contrast to those of the opposite side. The left leg is totally paralyzed and on being asked to move it he cautiously raises it with the help of the right or anesthetic leg.

Reflexes: The muscle reflexes are all exaggerated. Biceps and triceps tendon reflexes are active. The patellar tendon reflex is exaggerated. Ankle-clonus and Babinski's reflex are present in the left foot. The abdominal reflex is active. Cremasteric was not noted. Patient passed urine and stools involuntarily. No priapism was noted. No trophic disturbances—as bedsores or callouses were present at this time.

Dorsal aspect: Right side: The level of impaired sensation was limited to a little below the cephalic border of the scapula, embracing the right arm, leg and trunk to the median line, otherwise the dorsal conditions coincided with those on the ventral aspect.

With the history of the case and the symptoms as described I did not hesitate to declare it a Brown-Séquard paralysis following an injury to the fourth cervical vertebra, and in all probability a splintering of the lamina of the left side of the arch of this vertebra, injuring the left side of the cord at this level. The diagnosis of the height was warranted by the localized tenderness and level of anesthesia, coupled with the extent of motor paralysis and respiratory involvement. Carefully watching the case for several days it became apparent that the respirations were growing more shallow and rapid although pulse and temperature remained practically normal.

Fearing that the phrenic and long thoracic or respiratory nerve of Bell were becoming exhausted I urged operation at once, and on July 29th, 1904, a laminectomy was performed by Doctor William C. Phelps, the surgeon in charge of the ward. The hospital notes read as follows:

Operation: "Incision extending from the first cervical to the first thoracic vertebra. Exposure of the fourth and fifth cervical vertebræ. The lamina of the fourth was chiseled in two and removed with the spinous process. The cord was found on opening the dura to be considerably softened on the left side, and a great deal of cerebro-spinal fluid escaped; search for clot and depression was continued higher and spine of third vertebra removed. Wound was closed with catgut sutures—the dura with deep interrupted sutures."

Although the operation disclosed the softening or injury to the cord at the level of the fourth vertebra on the left side, it did not reveal the means by which this injury was inflicted, and in this respect was unsatisfactory. There was no fracture of the bodies of the vertebræ at the exposed region and no pressure upon the cord by blood clot or dislocated vertebræ. Following the operation there was an improvement in the respiration and the general condition was excellent. On August 2d, 1904, the first dressing and plaster of Paris collar removed. There was some discharge of cerebro-spinal fluid.

August 5.——Patient says that prick of pin is equally sharp on right and left arms and upper part of body. Condition of legs remains unchanged as regards sensation.

August 7.—Sensation still diminished on right side of body and right leg. Can move both arms to some extent. Wound nearly healed. Third dressing. General condition good and improving.

The change for the worse occurred during the night of August 7th, as the hospital notes again show.

August 28.—Patient is delirious and irrational at times. Right side of chest shows some dullness on percussion and rough breathing.

August 11.—Skin is becoming very harsh and dry. Emaciation is marked. Patient is rational and easily irritated. General condition is much poorer, and seems to be going down hill rapidly.

August 14.—Patient's condition is worse. Lies in semistupor most of time. Involuntary passage of feces and urine. Respirations are very shallow. First heart sound weakening.

August 16.—General condition very critical. Delirium and coma increased. Heart is weakening steadily. Can be only slightly roused.

August 19.—Gradually grew worse.

The above mentioned symptoms remaining unchanged until his death which occurred at 5.15 P. M.

During the last weeks of his illness bedsores had developed under the left elbow, sacrum and left heel and infection had undoubtedly taken place as temperature ranged from 103 to 105°F., pulse 110 to 130° and respirations from 30 to 50 per minute.

The autopsy was performed by Dr. Nelson G. Russell and the findings are as follows:

Nutrition: Little subcutaneous fat, atrophy on left side of body more marked than on the right.

There is present a scar over the cervical vertebræ.

Thorax: Lungs, *left,* normal appearance and consistency. Weight 16 ounces, *right,* lower lobe is firm, dark and has little consistency. Weight, 24 ounces.

Heart: normal.

Brain: Normal. Arteries not atheromatous.

Abdomen: not opened.

Spine: Compression of the spinal cord on both sides at the fourth and fifth cervical vertebræ by a spicule of bone, more apparent on the right side. The meninges are quite adherent to the vertebræ, also somewhat adherent to the spinal cord. No blood clot present and no dislocation. No gross destruction of the cord although for an inch or more it appeared softened and had a reddish grayish color. A small wedge-shape splinter about three-quarters of an inch long, with jagged edges, which was separated from the lamina of the right side of the fourth vertebra was displaced to the left and inward toward the cord, so that it pressed upon the dorsal surface of the cord about two-thirds of way across, and about one-third of left side of cord was not interfered with. The pressure of indentation was less than one-sixteenth inch in depth. The splinter was adherent to the dura and quite movable after the meninges were exposed. From the nature of the adhesions and the inflammatory conditions it is reasonable to infer that the splinter was dislodged at the time of the acident.

The cord was removed, hardened and stained by Pal and carmine methods but showed no distinct areas of secondary degeneration.

Little has been added to the brilliant observations of Brown-Séquard who first described the symptoms following a hemisection of the spinal cord in the year 1867, and the facts gleaned in the laboratory have been fortified by facts observed at the bedside. The sensory and motor paths of the cord can be nowhere better illustrated and defined than in a study of Brown-Séquard paralysis.

Turner, in *Brain,* 1891, collected and analyzed sixty cases of this affection reported up to that time, and since then I have been able to find sixty more cases.

Etiology: Stabwound, 16 cases; syphilitic meningo-myelitis, 13 cases; syphilitic embolism, 1 case; gumma, 1 case; hematomyelia, 8 cases; following tumors of the spinal cord, 7 cases; tubercular spondylitis, 4 cases; traumatic spondylitis, 1 case; solitary tubercle of the spinal cord, 2 cases; inflammatory process, 2 cases; chronic myelitis, 1 case; after laminectomy, 1 case.

Age: The oldest case was reported by Volkman in a man sixty-six years of age due to a glioma, the youngest by Hoffman in a boy sixteen years old, the result of a hematomyelia.

Sex: Of the fifty-one cases noted thirty-nine were males and twelve females. This is not surprising as this affection is par excellence one of the strenuous life. Of the twelve females, syphilitic meningo-myelitis was the cause of the lesion in 6, or 50 per per cent.

The left side of the cord was the seat of the disease in twenty-nine out of forty-seven cases noted, the right side in eighteen cases.

The prognosis of a Brown-Séquard paralysis is not as unfavorable as one would imagine, as the etiology in fifty per cent. of all cases is due either to stabwound or syphilis, both of which are amenable to treatment. My statistics show seventy-five per cent. of recoveries.

That the operation did not reveal the cause of the injury was disappointing—but not surprising.

Schultze, of Bonn, has reported a case of spinal cord tumor of the cervical region, where a laminectomy was performed by Schede, and the tumor not found, while at the autopsy the suspected tumor was found at the seat of operation partially hidden by the exposed cord.

That the diagnosis was at first considered as hysteria by the house staff is not to be wondered at, as analogous manifestations have been observed in true hysteria. Thus Rosenthal has reported a case of hysteria presenting a hemi-paresis with exaggerated reflexes and hyperesthesia on the *left* side—sensory disturbances analgesia, anesthesia and thermoanesthesia, with normal reflexes on the right side. Although the causes of a Brown-Séquard syndrome are varied, I have not been able to find a similar case where a splinter of bone split off from the lamella of the vertebra, has hemisected the cord.

Thorburn,[2] in an interesting paper on cases of injury to the cervical region of the spinal cord, reported nine cases, four of which were hematomyelia, the other 5 either fracture or fracture-dislocation. In only one case was there external deformity, there being in none of the others the slightest local indication of the

[2] Brain, Vol. 9, 1886, page 510.

severe injury which had been sustained. The anatomical sequellæ following a lesion at the fourth cervical segment are interesting and help to localize the seat of trouble at this segment. Particularly is this applicable to the phrenic or internal respiratory nerve of Bell, and the posterior thoracic or external respiratory nerve of Bell. The phrenic arises chiefly from the fourth cervical nerve, with a few filaments from the third, and a communicating branch from the fifth. Passing under the neck muscles it enters the thorax, passes in front of the root of the lung to the diaphragm, where it divides into branches which separately pierce the muscle and are distributed to its under surface. There is a slight difference in the course of the right and left phrenic nerves, but the origin and distribution are the same. Injury to the right phrenic nerve at its origin, or cephalad to the fourth cervical nerve, will produce paralysis of the right side of the diaphragm, and a restriction of the pulmonary capacity on this side would be the result.

The posterior thoracic nerve arises sometimes from two roots —the fifth and sixth cervical but generally from three—the fifth, sixth and seventh nerves, and extends down along the side of the chest to the lower border of the serratus magnus muscle supplying branches to each of it digitations. There are also two of these nerves, right and left. Injury to the right posterior thoracic or to the spinal cord cephalad to the fifth cervical nerve, will produce paralysis of the right serratus magnus muscle, and a partial failure of the raising and everting of the ribs in the act of inspiration. There results then a marked difference between the excursions of the right and left sides of the thorax, as noted in the history of the case, and as a final result the development of a hypostatic pneumonia of the right lung, diagnosed at the bedside and verified in the morgue.

The left side of the chest and the left lung were not in any way involved.

The case described merits consideration because it is:

1. The only case reported of a lesion in one-half of the spinal cord—not due to stabwound, tumor, hemorrhage, dislocation or a syphilitic meningo-myelitis but to a splintering of the lamella without fracture of the body of the vertebra.

2. It is the only case so far reported where a laminectomy has